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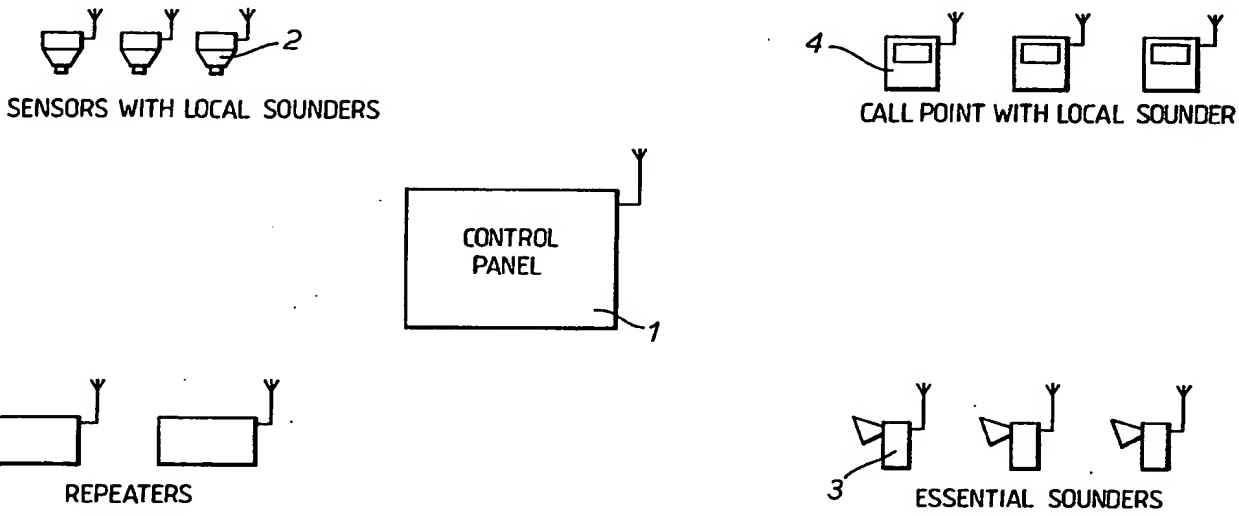

(57) Abstract

A fire detection system includes a number of integrated alarm/detection units (2) mounted in different locations. A control unit (1) transmits and receives radio signals to and from the alarm/detection units (2). Each alarm/detection unit (2) has a fire detector and an alarm for generating an audible or visible alarm signal. The unit includes a local control processor (5) connected in common to the detector and to the alarm. A radio transceiver is connected to the local control processor. The alarm/detection unit has a battery power supply. The control processor (5) is arranged to switch ON in a predetermined time slot, and when ON to switch between an idle mode and an active mode. The processor when in the active mode transmits to the control unit data indicative of the operational status of the alarm/detection system.

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FIRE DETECTION SYSTEM

BACKGROUND TO THE INVENTION

The present invention relates to a fire detection and alarm system, and in particular to a system of the type comprising several detector units in different locations linked to a central control unit.

Fire alarm systems for use on anything other than the smallest domestic scale, in general need a central control unit to monitor the state of the different detectors, to control the activation of the alarm sounders, and to provide an indication of the location of a detected fire. Conventionally it has been necessary to provide wiring running from the detectors to the control unit and from the control unit to the alarm sounders.

It has previously been proposed to use radio links between the detectors and the control unit. Each detector is provided with a radio transmitter and transmits a coded signal to the control unit when a fire is detected. However with known systems, it has still been necessary to provide wiring to link the control unit to the alarm sounders. It has not been thought practical to use radio links for the alarm sounders in view of the difficulty of designing the sounders as stand-alone units. In particular, it is essential that a sounder has adequate power available to sustain an alarm state when appropriate. This places tight constraints on the power budget available for the operation of a sounder designed as a stand-alone unit.

SUMMARY OF THE INVENTION

According to the present invention, a fire detection system comprises a multiplicity of integrated alarm/detection units arranged to be mounted in different locations, and a control unit arranged to transmit and receive radio signals to and from the alarm/detection units,

each alarm/detection unit comprising a fire sensor alarm means for generating an audible or visible alarm signal, a local control processor connected in common to the sensor and the alarm means, a radio transceiver connected to the local control processor, and a battery power supply for the unit,

the control processor being arranged to switch ON in a predetermined time slot, and when ON to switch between an idle mode and an active mode, the processor when in the active mode transmitting to the control unit data indicative of the operational status of the alarm/detection unit.

The present invention provides a fire detection system capable of totally wire-less operation. This is made possible by an arrangement in which the detection and alarm units are integrated in a single housing sharing a common power supply, and controlled by a common control processor. The control processor is powered up only when a predetermined communication time slot occurs, or when, e.g., smoke is detected. During the short power-ON time, the control processor is switched between ACTIVE and IDLE states, reducing the operating power required. Once certain operations have been initiated by the processor, it can switch to the low power IDLE state until the operation is complete. While the processor is ON it "reports" back to the control unit on the status of both the fire detection unit, the alarm, and the associated power supply. It has been found possible with such an arrangement to provide extended periods of operation using just a small battery power supply, while still achieving enhanced levels of reliability in operation. Many practical advantages arise from the wire-less nature of the system. The system is much simpler to install and does not result in the disruption and need for redecoration which often results from the installation of conventional wired networks. The absence of wires, and the fact that the alarm/detection unit only requires a relatively small housing, makes the

system as a whole far less visually obtrusive than conventional systems.

Preferably each of the multiplicity of alarm/detection units is arranged to turn ON and to transmit to the control unit in a different predetermined time slot, and the control unit is arranged to identify transmission from different units on the basis of different respective time slots.

Preferably the control unit is arranged to transmit regularly a synchronising signal to the alarm/detection units, the alarm/detection units timing their return transmissions to the control unit in response to the synchronising signal.

BRIEF DESCRIPTION OF THE DRAWINGS

An example of a system in accordance with the present invention will now be described in detail with reference to the accompanying drawings, in which:

Figure 1 is a block diagram showing schematically the components of the system;

Figure 2 is a block diagram showing the central control unit; and

Figure 3 is a block diagram showing an alarm/detection unit.

DETAILED DESCRIPTION OF EXAMPLE

A fire detection and alarm system comprises a central control unit 1 and a number of detector/alarm units 2. In the present example the alarm/detection units 2 incorporate an ionisation detector which responds to the presence of smoke, and a sounder arranged to provide an audible alarm.

Other detector types, such as optical detectors, fixed temperature detectors or rate of rise heat detectors, may also be incorporated within the system.

Stand-alone sounders 3 and alarm call-points 4 are also provided.

The control unit 1, alarm/detection units 2, sounders 3 and call-points 4 each incorporate radio transceivers. In use, the system carries out two main functions. Firstly, the control unit 1 continually monitors the status of the different components of the system to ensure that they are all functioning reliably and/or to generate an appropriate fault indication when a component failure is detected. Secondly, when an alarm condition, such as the presence of smoke, is detected then the control panel receives data indicating the alarm condition from the relevant detection unit, and generates and transmits control signals to initiate the sounding of the alarm. In the present example the unit has a housing of 120 mm diameter and 90 mm depth.

Figure 2 is a block diagram showing schematically the structure of the central control unit 1. The operation of the unit is controlled by a microprocessor 5. The programme for the microprocessor 5 is stored in a socketed EPROM 6. Dedicated regions of memory are also provided for system information 7 and to store information 8. The microprocessor 5 communicates data from the other components of the system via radio transceiver modules 9,10. The modules are duplicated to ensure that if one module fails, the control unit can still function using the other module.

The radio modules operate at a frequency in the present example of 173.225 MHz transmitting and receiving FSK encoded digital data. Data is communicated between the microprocessor 5 and the coders/decoders of the radio modules 9,10 at a rate of 600 Baud. The maximum transmission power from each radio module is 10 mW with the normal operational power being 1 mW.

The control unit incorporates RS232C communication ports for connection to maintenance equipment. A printer

port 12 is also provided. A key pad 13 comprises keys for the following functions:

a) evacuate
b) silence alarms
c) reset
d) clear fault message
e) isolate auxiliaries.

A liquid crystal display 14 is mounted on the housing of the control unit and is used to provide the user with data such as fire location, fault location, maintenance information, and date and time. Separate illuminated coloured numeric indicators are provided in addition, with one colour indicating the number of a sensor reporting a fault and another colour indicating the number of a sensor reporting a fire.

The control unit is powered by a sealed lead acid battery charged continuously from the mains using a conventional constant voltage charging circuit. The control unit incorporates a local sounder 15 which provides a low level audible output when it is operating for warnings.

Figure 3 is a block diagram showing the structure of a sensor unit. The unit incorporates both a sensor 16 and a sounder 17 mounted in a single housing. A control circuit 18 monitors the output of the sensor 16 and, when appropriate, outputs a control signal to drive the sounder 17. Data is communicated between the control circuit 18 and a radio transceiver module 19. The structure of the module 19 is shown in greater detail in Figure 3. Common control logic and switching logic is used for both the transmitter and receiver stages. The switching logic controls crystal oscillators 21,22 formed in the RX and TX stages. Only one of the oscillators is normally on at a time, again reducing the power consumption. This is possible because with the use of time slots, there is generally no need for a fast change-over from RX to TX.

During an ALARM state however a fast change-over is required, and so then both oscillators are powered.

In the present example, the receiver and the switching circuit are both devices manufactured by Philips with product numbers SL6649 and NE630 respectively.

The processor 20 incorporates an oscillator formed by a ceramic resonator which gives a greatly reduced settling time. This facilitates a much faster program start on power-up with a consequent saving in power, as described in further detail below.

The sensor unit is powered by four AA batteries via a DC-DC convertor which converts the voltage up to a level of 5 volts. Alternatively, a microprocessor operating at 3 volts may be used, and the output of the DC-DC convertor adjusted accordingly. In practice then the output from the convertor is likely to be set to a value from 3 to 5.5 volts. The batteries are capable of operating the sounder for a period of at least 1.5 hours on a minimum of two occasions before becoming exhausted. The microprocessor 20 in the control circuit 18 regularly monitors the condition of the batteries.

A number of bits switches associated with the microprocessor 20 are used to configure the unit and select optional functions. The bit switches are also used to set a unique identifying number for the unit. A clock circuit "wakes up" the microprocessor 20 on a regular basis to perform fire detection and maintenance activities. At other times the control circuit 18 and transceiver 19 remain in an idle state in which power consumption is minimised. One of the functions of the microprocessor 20 is to control the power transmission level of the transceiver to the minimum required for reliable communication.

Any one of a number of conventional transducers may be used for the sensor 16. Possible transducer types include standard dual ionisation chambers, optical detectors, heat rate of rise detectors and temperature level detectors.

In addition to the integrated detection/alarm units described above, the units incorporated in the system may include stand-alone sounders housing a loud audible generator capable of exceeding 85 dB at three metres. A radio module similar to that described for the detector/alarm units receives commands from the control unit and transmits back to the control unit details of any fault conditions.

Manual call-points incorporating break glass switches are also included in the system. Again these incorporate transceiver modules for communicating with the central control unit.

In use, the system has four possible states:

1. Normal
2. Fault
3. Alarm
4. Maintenance

The front panel of the control unit will indicate its current status.

1. NORMAL

In this condition the control panel will be functioning correctly with power available from the mains to charge the internal batteries. All of the detectors, break glass switches, sounders etc. will be sending confirmation that they are functioning correctly.

All the audible and visual alarms will be disabled and the control unit will be polling each of the detectors for information on a regular basis.

2. FAULT

A fault condition can be initiated by any of the detectors, break glass switches, sounders etc. or by the control panel itself.

Information regarding the fault will be displayed by the control panel on its LCD display. The information will include a description of the fault, which zone the faulty

unit is in and the location of the faulty unit. This information will be time stamped and added to the computers log.

Any fault detector will also have its identification number displayed on a yellow numeric display.

3. ALARM

A fire alarm can be initiated by one or more detectors or break glass switches. The audible alarm will sound in the activated unit immediately if it is enabled, and an alarm state will be broadcast by its radio transmitter.

The control panel will give an audible warning and display the location of the fire on the LCD panel. In addition the identification number of the detector which is transmitting the alarm will be displayed on a red numeric indicator.

The control panel will transmit an alarm condition to the essential sounders for immediate operation and will set each of the detectors to a pre-alarm state.

The individual detectors will remain in a self-timed pre-alarm condition for five minutes before standing down. During the five minute period an evacuate command can be initiated from the control panel which will cause the sounders within each of the detectors to operate.

If the control panel continues to transmit an alarm signal after the five minute period then the detectors will again be polled to the pre-alarm state.

The silence alarm switch on the control panel can be operated at any time and will deactivate all sounders operating at that point in time. It will also cancel the pre-alarm transmission.

4. MAINTENANCE

A maintenance mode can be initiated from the control panel, which will transmit a code to each of the detectors. When the full maintenance state has been established by each detector, they will perform a special routine to

enable each detector to be tested with a smoke generator. Whilst in this mode the detector will give an intermittent local alarm to confirm that it has received the communication from the control panel and has detected the smoke.

5. TRANSMISSIONS

To avoid radio transmissions overlapping, a time slot will be allocated to each detector. A synchronising signal will be transmitted to the detectors by the control panel.

There will be an alarm period during which any detector can report the detection of a fire.

As each detector reaches its allocated time slot it will send its report. Should an alarm condition be received, the detector will respond to the alarm transmissions appropriately.

Each time frame starts with a base station timing transmission. This is received by each of the units in the system which then synchronise to that transmission to ensure synchronous operation with the central control unit.

As seen in the figure, the 24 second timing frame is based on a structure of sub-frames of 0.75 seconds length. The time slots for transmissions by individual units to the central control unit occupy the first 0.4 seconds of this sub-frame. This is followed by a slot for the transmission of a fire alarm signal from any unit, followed by a slot for transmission by a repeater of a fire alarm signal, then a slot for an acknowledgement transmission from the control unit and finally a slot for an acknowledgement from the repeater to one of the alarm/detection units.

In the present example, slots are provided for up to 240 detectors divided into 15 zones of 16 detectors each numbered 0-15. Since the more distant detectors may be too far for direct transmission/reception from the central control unit, a repeater unit (21) may be used to receive and transmit on signals to and from those detectors.

Accordingly slots are provided within the timing frame for transmissions by the repeater.

The repeaters perform the function of extending the range of the radio, by effectively repeating any Control Station message and alarm/detector unit replies. The alarm/ detector unit replies are stored in the repeater, and communicated together in a coded format, to reduce the power-on time of the repeater and reduce communication activity. This coded information is transmitted the next time the repeater transmits a repeat SYNC message from the Control Unit. This message is therefore communicating information in both directions, a SYNC message out to the alarm/detector units and alarm/detector replies (fault codes etc.) back to the Control Unit.

Only normal fault reporting messages are repeated in this format. Alarm and tamper messages are repeated completely as soon as received in the alarm repeater slot.

Each detection unit incorporates a real-time clock which is synchronised to the transmissions from the central control unit as already described. The detection unit remains with the power to the microprocessor turned OFF until its allotted time slot in the 24 second time frame is reached. At that point, the microprocessor in the detection unit determines the status of the different elements of the unit, and generates a fault code which is transmitted back to the central control unit. After initiating the appropriate actions the microprocessor switches into an IDLE mode. At the end of the allotted time slot, the given unit then switches its microprocessor OFF. The fault code may indicate any one of a range of states including DETECTOR NORMAL, TIMING BATTERY LOW, TIMING BATTERY FAIL, DETECTOR TEST FAIL, RADIO FAILURE, ALERT STATE or ALARM STATE.

Normally, after the end of its allotted time slot, the unit remains with most of its circuits, including the microprocessor, powered-down, for the remainder of the 24 second time frame. If however at any time the sensor

detects and alarm condition, such as the presence of smoke, then this triggers the immediate return of the unit to the active state. The unit then transmits an alarm code back to the central unit in the next fire transmission slot, one fire transmission slot being provided in each of the 0.75 second sub-frames. The transmission of alarm codes is essentially asynchronous. However, since the times at which the different units power-up and perform a fire detection test are arranged to be different, depending on the identification number of the unit, then only a limited number of units should try to communicate an alarm condition within each time slot. Each unit listens before transmitting, checking that the time slots are free. The units each wait a different set time before transmitting and this staggered start further reduces the likelihood of radio communication clashes. If as a result of a clash or otherwise the transmission is not clearly received or decoded, then the base station does not generate the appropriate alarm acknowledgement code. In this case the or each detection/alarm unit will repeat the alarm code, until it is successfully received and an appropriately addressed acknowledgement signal is received.

As well as acknowledging the original transmission, the control panel will subsequently transmit control signals to individual detectors either to cause the detector unit to operate its in-built sounder or to set the unit to a pre-alarm state.

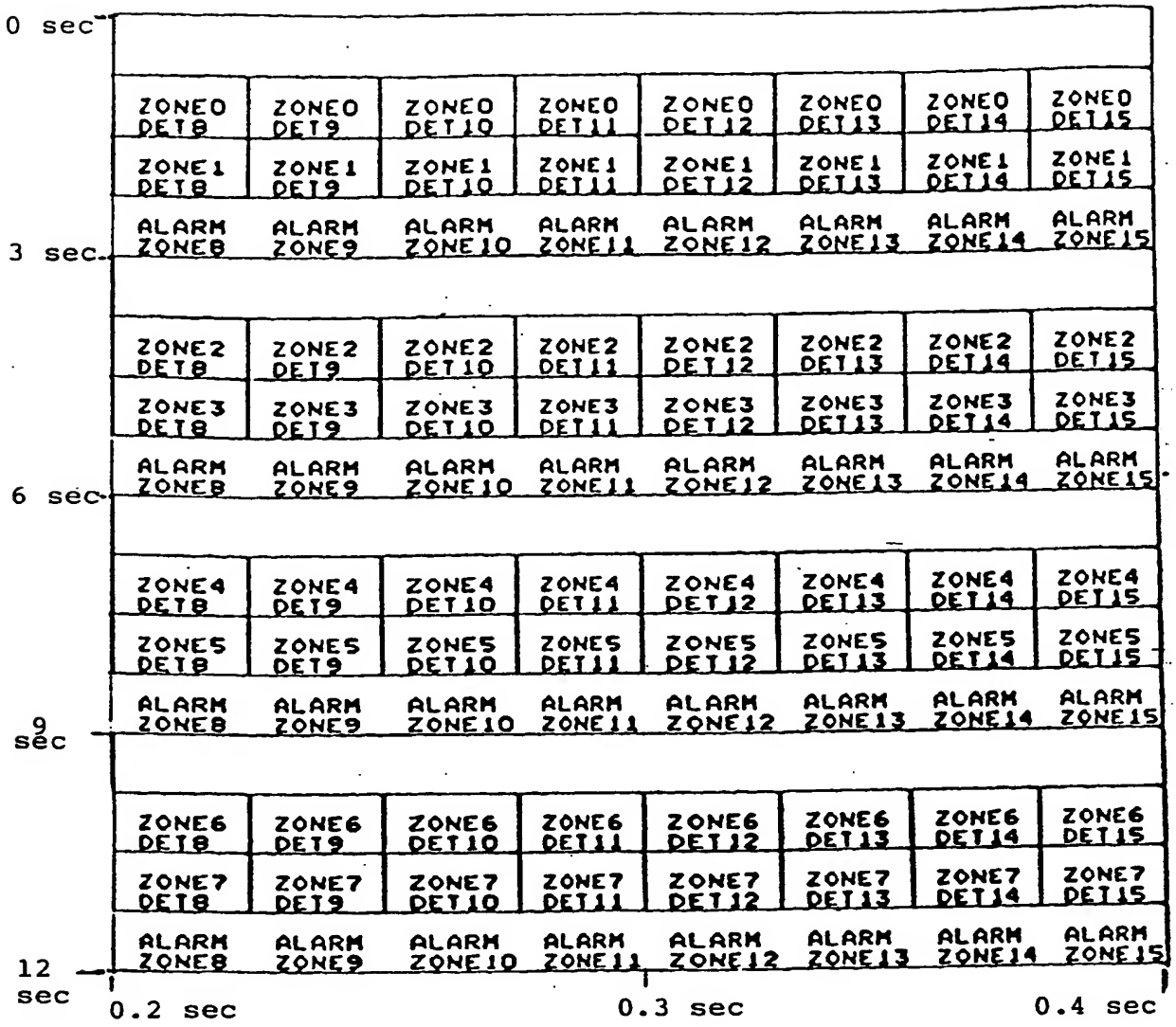
Table 1 below is, for the sake of clarity, split in two parts. Table 1a shows the portion of each sub-frame from 0 to 0.4 seconds and table 1b shows the remainder of each sub-frame extending to 0.75 seconds - the subframe duration. The duration of the entire frame is 24 seconds. Tables 2a to 2i show the format of transmissions between the different elements of the system.

TABLE 1a (i)

0 sec	BASE SIN TIMING TRANSMISSION				REPEATER for ZONE1			
	ZONE0 DET0	ZONE0 DET1	ZONE0 DET2	ZONE0 DET3	ZONE0 DET4	ZONE0 DET5	ZONE0 DET6	ZONE0 DET7
	ZONE1 DET0	ZONE1 DET1	ZONE1 DET2	ZONE1 DET3	ZONE1 DET4	ZONE1 DET5	ZONE1 DET6	ZONE1 DET7
	ALARM ZONE0	ALARM ZONE1	ALARM ZONE2	ALARM ZONE3	ALARM ZONE4	ALARM ZONE5	ALARM ZONE6	ALARM ZONE7
3 sec	REPEATER for ZONE2				REPEATER for ZONE3			
	ZONE2 DET0	ZONE2 DET1	ZONE2 DET2	ZONE2 DET3	ZONE2 DET4	ZONE2 DET5	ZONE2 DET6	ZONE2 DET7
	ZONE3 DET0	ZONE3 DET1	ZONE3 DET2	ZONE3 DET3	ZONE3 DET4	ZONE3 DET5	ZONE3 DET6	ZONE3 DET7
	ALARM ZONE0	ALARM ZONE1	ALARM ZONE2	ALARM ZONE3	ALARM ZONE4	ALARM ZONE5	ALARM ZONE6	ALARM ZONE7
6 sec	REPEATER for ZONE4				REPEATER for ZONE5			
	ZONE4 DET0	ZONE4 DET1	ZONE4 DET2	ZONE4 DET3	ZONE4 DET4	ZONE4 DET5	ZONE4 DET6	ZONE4 DET7
	ZONE5 DET0	ZONE5 DET1	ZONE5 DET2	ZONE5 DET3	ZONE5 DET4	ZONE5 DET5	ZONE5 DET6	ZONE5 DET7
	ALARM ZONE0	ALARM ZONE1	ALARM ZONE2	ALARM ZONE3	ALARM ZONE4	ALARM ZONE5	ALARM ZONE6	ALARM ZONE7
9 sec	REPEATER for ZONE6				REPEATER for ZONE7			
	ZONE6 DET0	ZONE6 DET1	ZONE6 DET2	ZONE6 DET3	ZONE6 DET4	ZONE6 DET5	ZONE6 DET6	ZONE6 DET7
	ZONE7 DET0	ZONE7 DET1	ZONE7 DET2	ZONE7 DET3	ZONE7 DET4	ZONE7 DET5	ZONE7 DET6	ZONE7 DET7
12 sec	ALARM ZONE0	ALARM ZONE1	ALARM ZONE2	ALARM ZONE3	ALARM ZONE4	ALARM ZONE5	ALARM ZONE6	ALARM ZONE7

0.0 sec 0.1 sec 0.2 sec

TABLE 1a (ii)


0 sec
3 sec
6 sec
9 sec
12 sec
0.2 sec
0.3 sec
0.4 sec
ZONE0 DET8
ZONE0 DET9
ZONE0 DET10
ZONE0 DET11
ZONE0 DET12
ZONE0 DET13
ZONE0 DET14
ZONE0 DET15
ZONE1 DET8
ZONE1 DET9
ZONE1 DET10
ZONE1 DET11
ZONE1 DET12
ZONE1 DET13
ZONE1 DET14
ZONE1 DET15
ALARM ZONE8
ALARM ZONE9
ALARM ZONE10
ALARM ZONE11
ALARM ZONE12
ALARM ZONE13
ALARM ZONE14
ALARM ZONE15
ZONE2 DET8
ZONE2 DET9
ZONE2 DET10
ZONE2 DET11
ZONE2 DET12
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ZONE3 DET8
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ZONE7 DET8
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ZONE7 DET11
ZONE7 DET12
ZONE7 DET13
ZONE7 DET14
ZONE7 DET15
ALARM ZONE8
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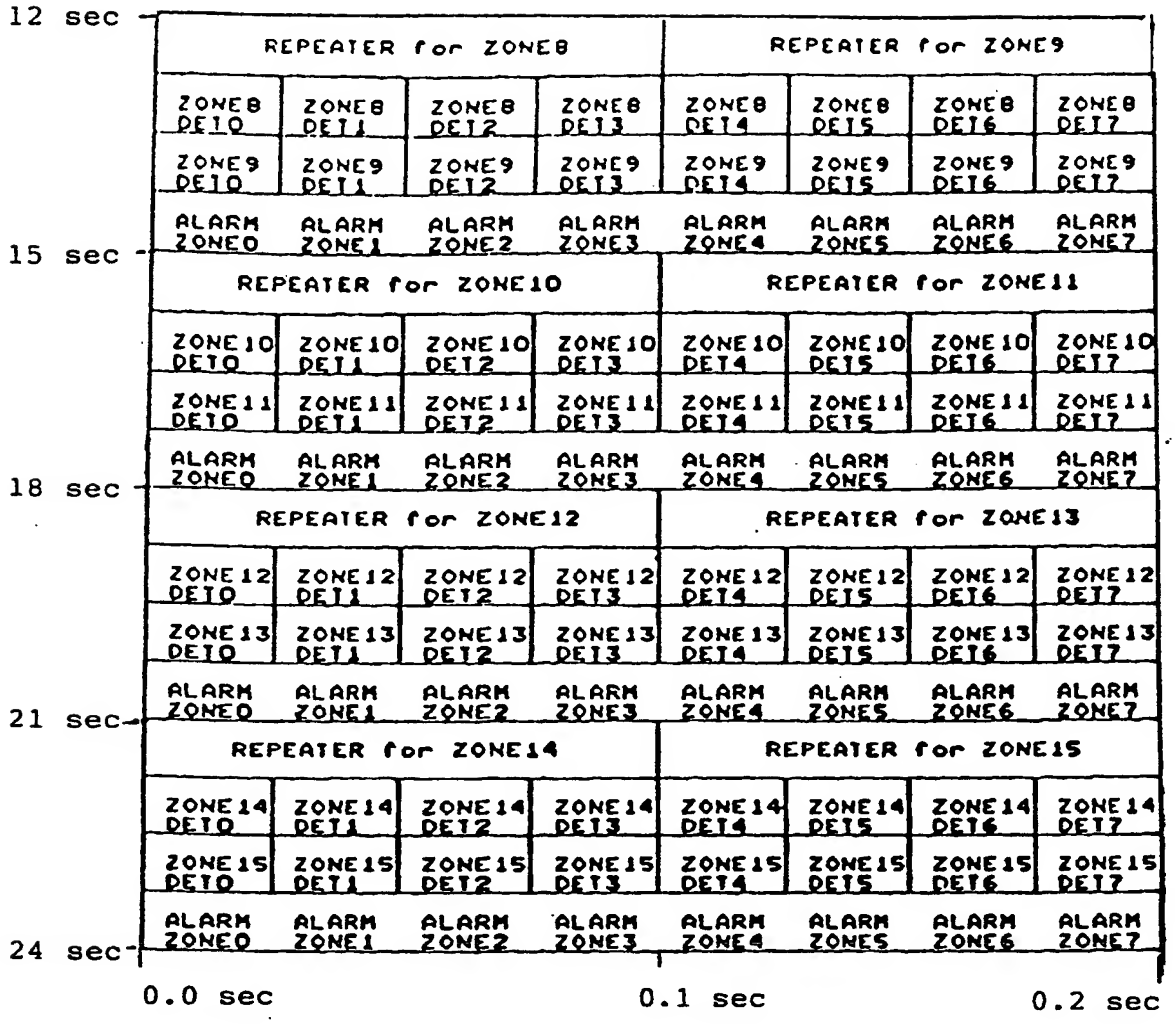
ALARM ZONE14
ALARM ZONE15

TABLE 1a (iii)


12 sec
15 sec
18 sec
21 sec
24 sec
REPEATER for ZONE8
REPEATER for ZONE9
REPEATER for ZONE10
REPEATER for ZONE11
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REPEATER for ZONE13
REPEATER for ZONE14
REPEATER for ZONE15
ZONE8 DET0
ZONE8 DET1
ZONE8 DET2
ZONE8 DET3
ZONE8 DET4
ZONE8 DET5
ZONE8 DET6
ZONE8 DET7
ZONE9 DET0
ZONE9 DET1
ZONE9 DET2
ZONE9 DET3
ZONE9 DET4
ZONE9 DET5
ZONE9 DET6
ZONE9 DET7
ALARM ZONE0
ALARM ZONE1
ALARM ZONE2
ALARM ZONE3
ALARM ZONE4
ALARM ZONE5
ALARM ZONE6
ALARM ZONE7
ZONE10 DET0
ZONE10 DET1
ZONE10 DET2
ZONE10 DET3
ZONE10 DET4
ZONE10 DET5
ZONE10 DET6
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ZONE15 DET1
ZONE15 DET2
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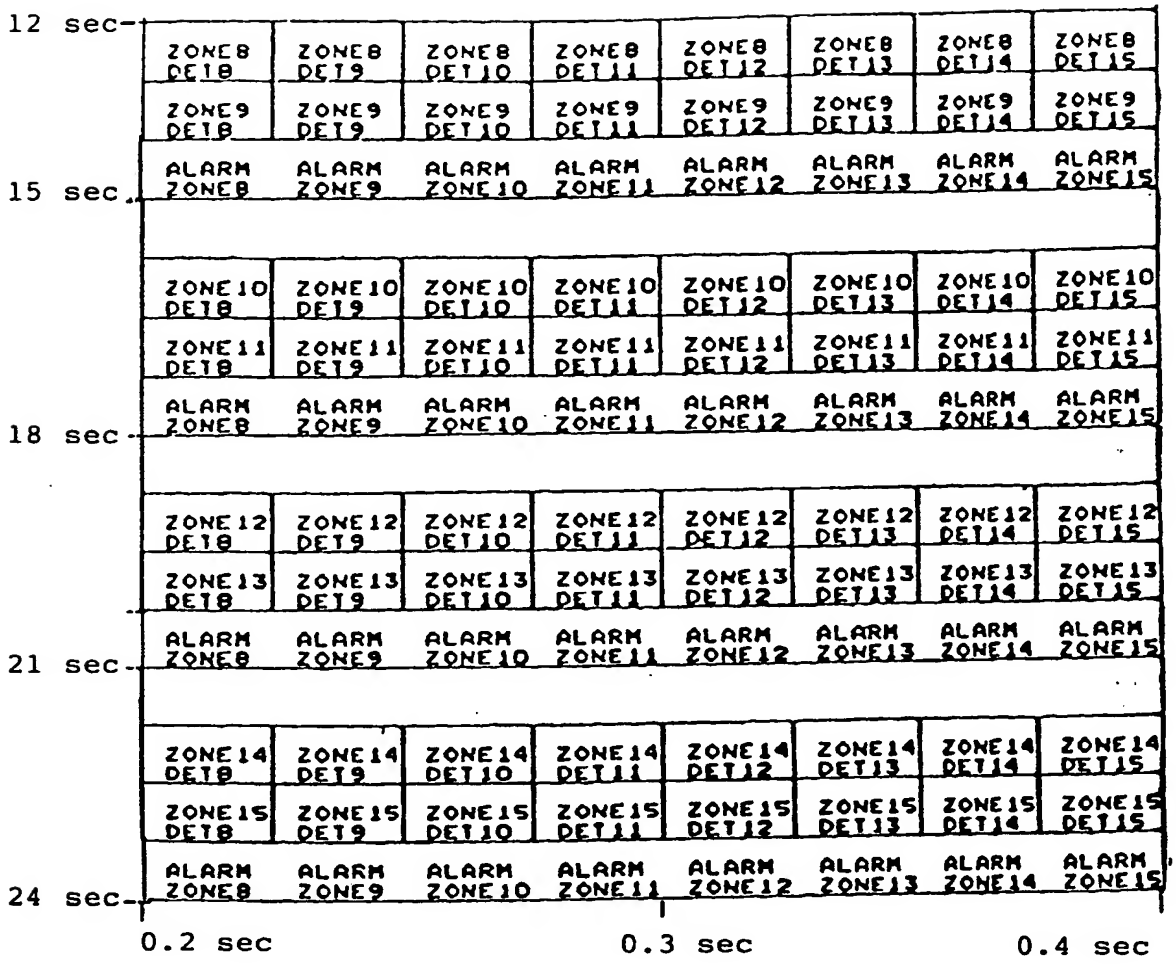
0.0 sec
0.1 sec
0.2 sec

TABLE 1a (iv)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ALARM ZONE11
ALARM ZONE12
ALARM ZONE13
ALARM ZONE14
ALARM ZONE15
ZONE14 DET8
ZONE14 DET9
ZONE14 DET10
ZONE14 DET11
ZONE14 DET12
ZONE14 DET13
ZONE14 DET14
ZONE14 DET15
ZONE15 DET8
ZONE15 DET9
ZONE15 DET10
ZONE15 DET11
ZONE15 DET12
ZONE15 DET13
ZONE15 DET14
ZONE15 DET15
ALARM ZONE8
ALARM ZONE9
ALARM ZONE10
ALARM ZONE11
ALARM ZONE12
ALARM ZONE13
ALARM ZONE14
ALARM ZONE15
0.2 sec
0.3 sec
0.4 sec

TABLE 1b (i)

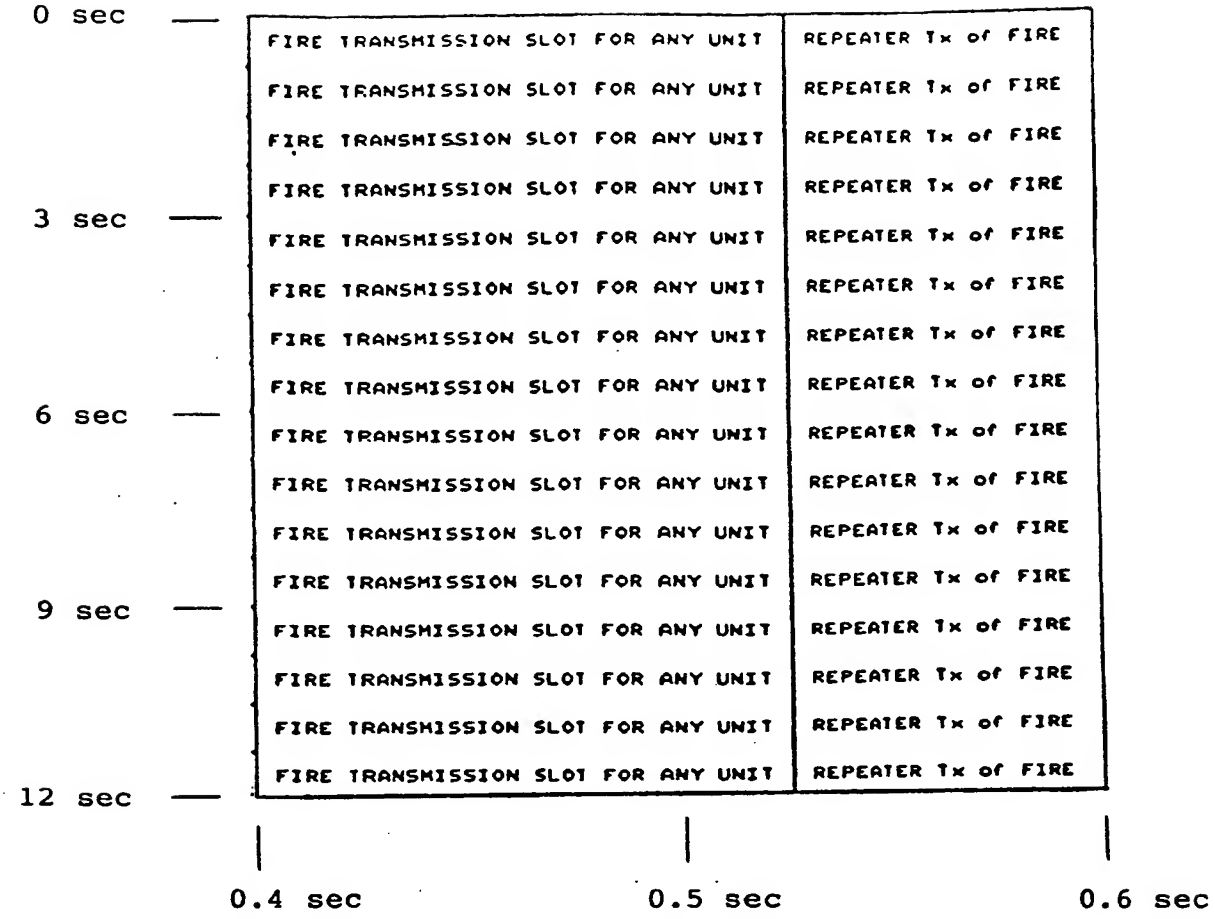

0 sec
3 sec
6 sec
9 sec
12 sec
FIRE TRANSMISSION SLOT FOR ANY UNIT
REPEATER Tx of FIRE
0.4 sec
0.5 sec
0.6 sec

TABLE 1b (ii)

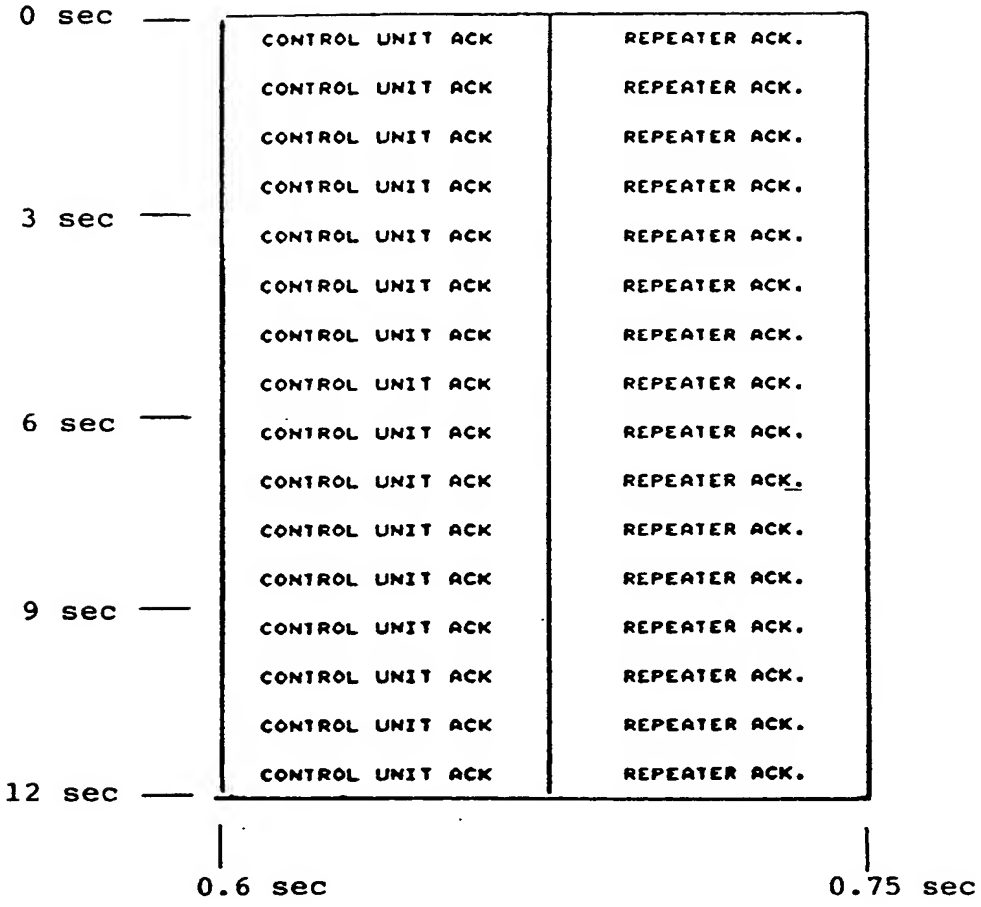

0 sec
3 sec
6 sec
9 sec
12 sec
CONTROL UNIT ACK
REPEATER ACK.
0.6 sec
0.75 sec

TABLE 1b (iii)

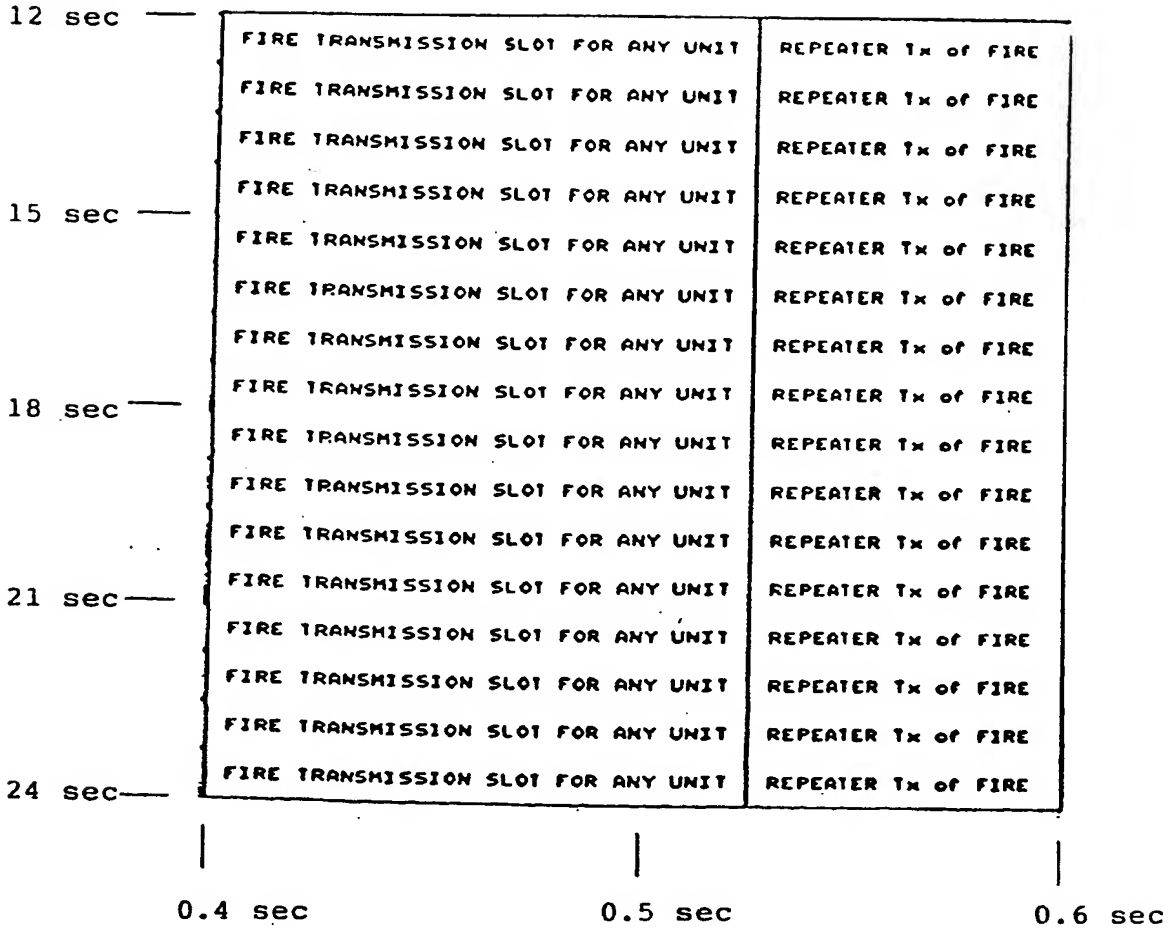

12 sec
15 sec
18 sec
21 sec
24 sec
FIRE TRANSMISSION SLOT FOR ANY UNIT
REPEATER Tx of FIRE
0.4 sec
0.5 sec
0.6 sec

TABLE 1b (iv)

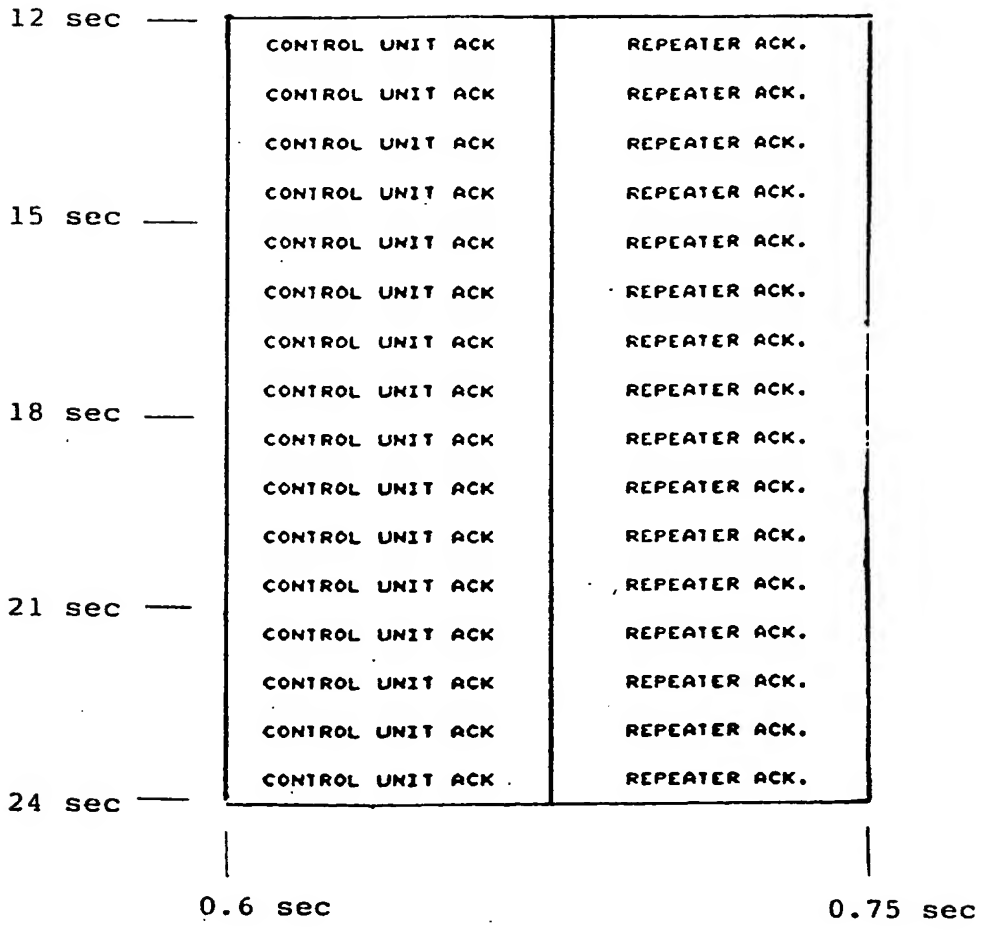

12 sec
15 sec
18 sec
21 sec
24 sec
CONTROL UNIT ACK
REPEATER ACK.
0.6 sec
0.75 sec

TABLE 2 (A)

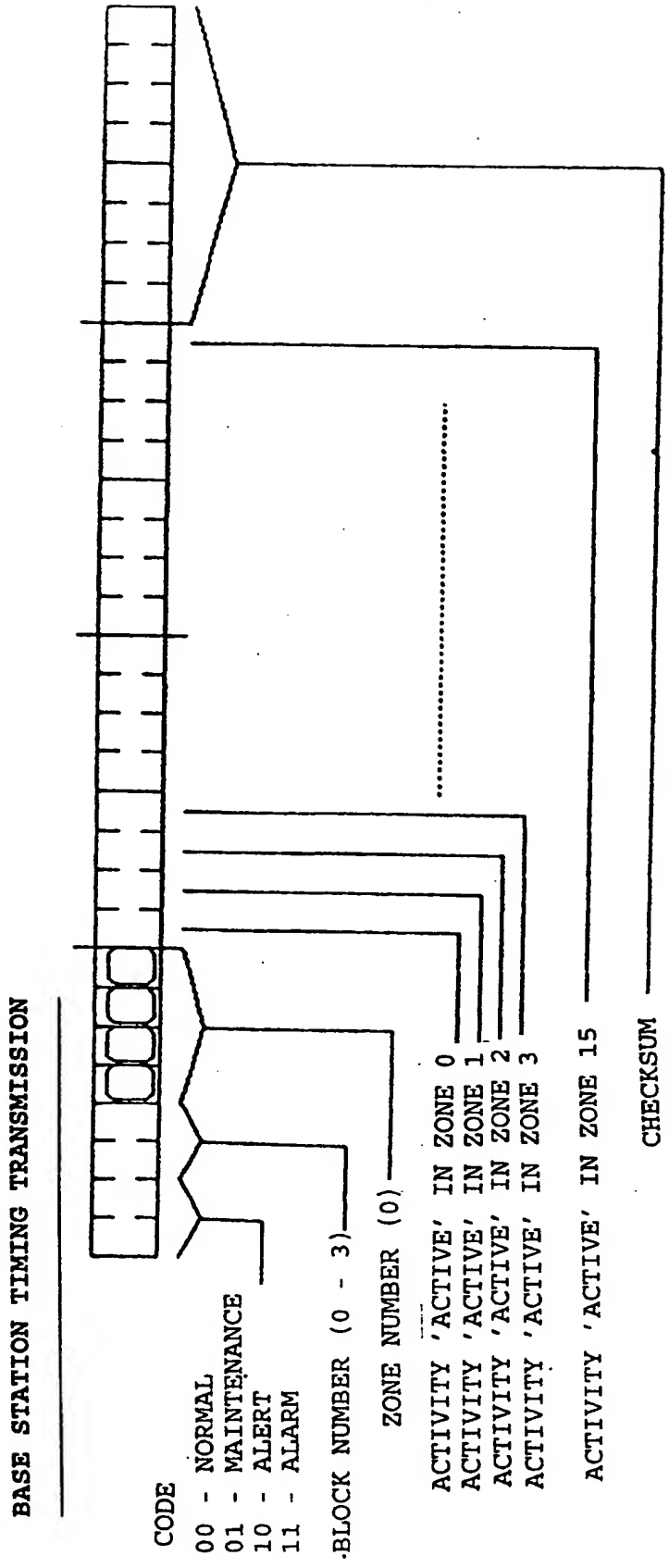

BASE STATION TIMING TRANSMISSION
CODE
00 - NORMAL
01 - MAINTENANCE
10 - ALERT
11 - ALARM
BLOCK NUMBER (0 - 3)
ZONE NUMBER (0)
ACTIVITY 'ACTIVE' IN ZONE 0
ACTIVITY 'ACTIVE' IN ZONE 1
ACTIVITY 'ACTIVE' IN ZONE 2
ACTIVITY 'ACTIVE' IN ZONE 3
ACTIVITY 'ACTIVE' IN ZONE 15
CHECKSUM

TABLE 2 (B)

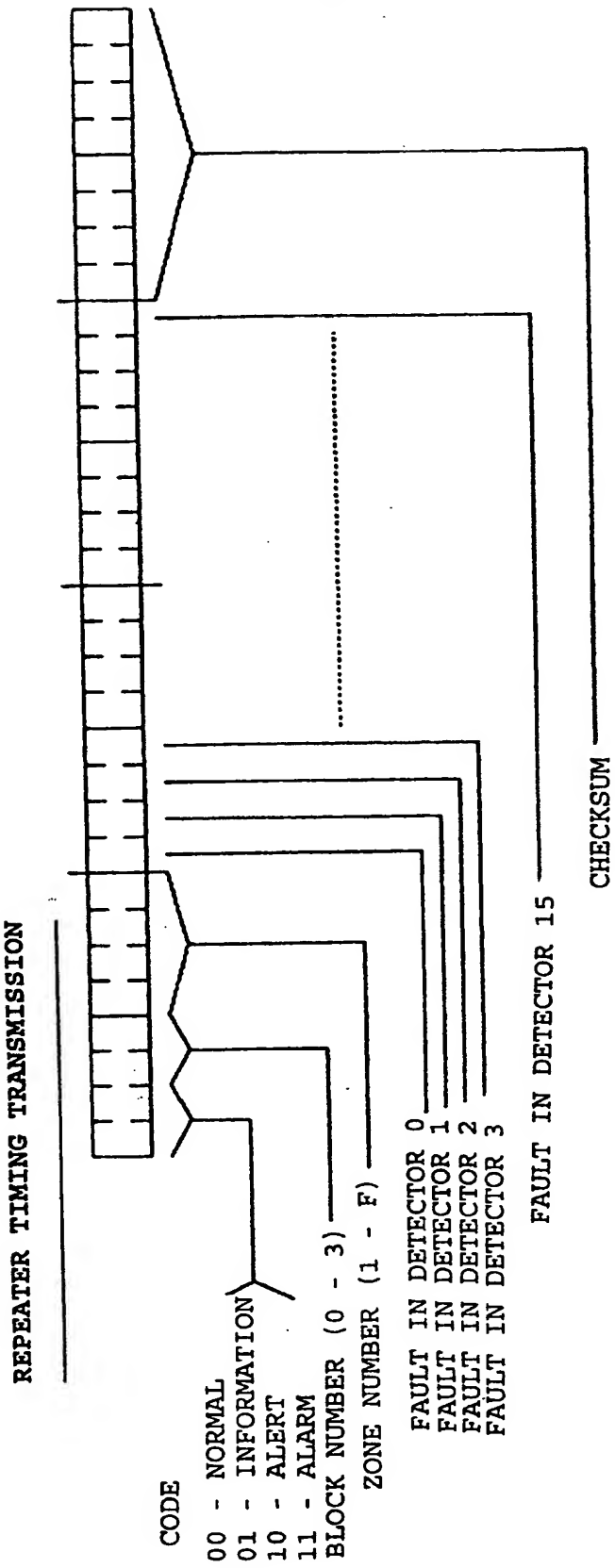
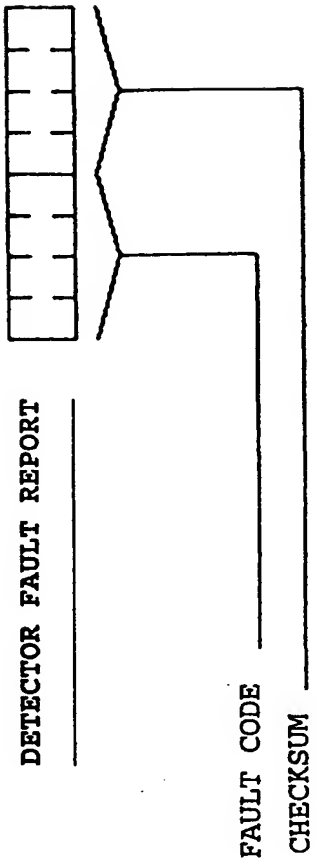

REPEATER TIMING TRANSMISSION
CODE
00 - NORMAL
01 - INFORMATION
10 - ALERT
11 - ALARM
BLOCK NUMBER (0 - 3)
ZONE NUMBER (1 - F)
FAULT IN DETECTOR 0
FAULT IN DETECTOR 1
FAULT IN DETECTOR 2
FAULT IN DETECTOR 3
FAULT IN DETECTOR 15
CHECKSUM

TABLE 2 (C)



FAULT CODES	DESCRIPTION
0	DETECTOR NORMAL
1	PRIMARY BATTERY LOW
2	PRIMARY BATTERY FAIL
3	BACKUP BATTERY LOW
4	
5	DETECTOR TEST FAIL
6	RADIO FAILURE
7	OSCILLATOR FAILURE
8	SELFTEST FAILURE
9	
10	MAINTENENCE MODE - NORMAL
11	MAINTENENCE MODE - ALARM
12	PADDED OUT - NORMAL
13	PADDED OUT - ALARM
14	ALERT STATE
15	ALARM STATE

TABLE 2 (D)

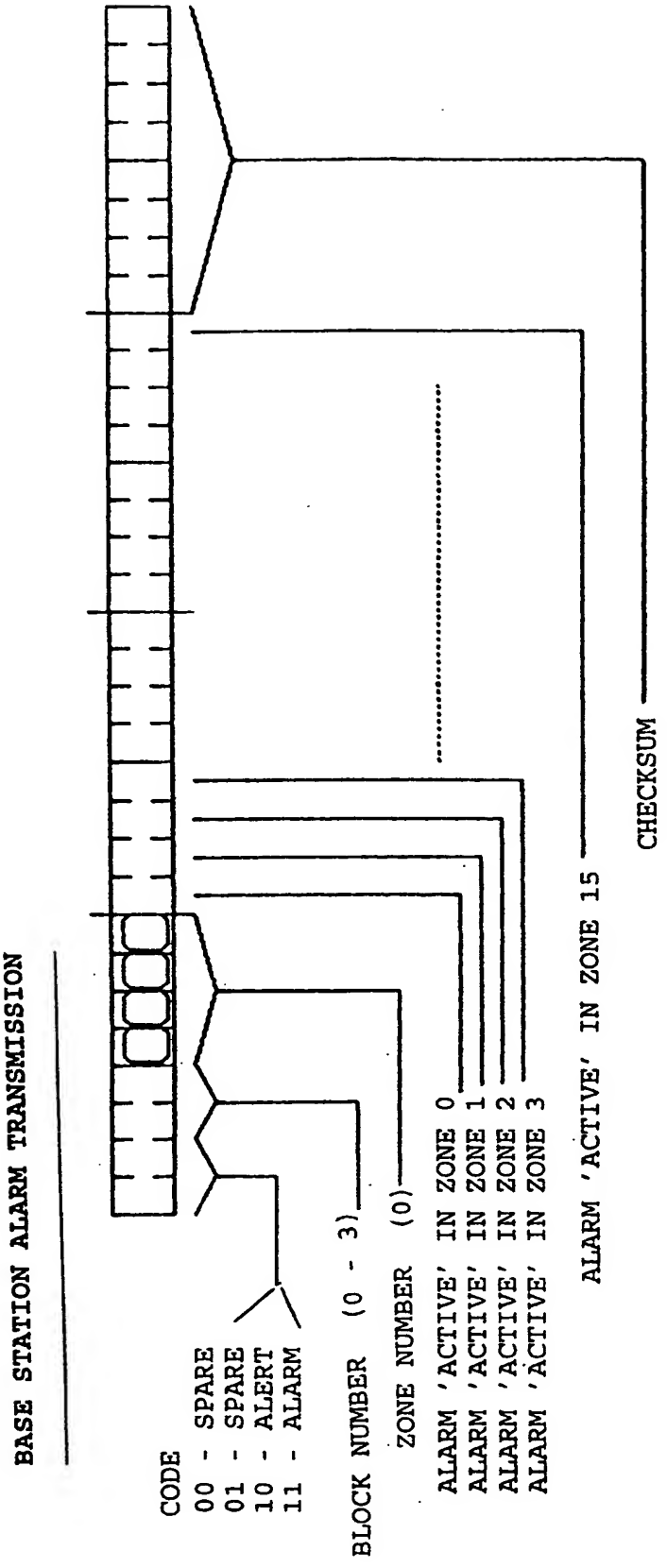

BASE STATION ALARM TRANSMISSION
CODE
00 - SPARE
01 - SPARE
10 - ALERT
11 - ALARM
BLOCK NUMBER (0 - 3)
ZONE NUMBER (0)
ALARM 'ACTIVE' IN ZONE 0
ALARM 'ACTIVE' IN ZONE 1
ALARM 'ACTIVE' IN ZONE 2
ALARM 'ACTIVE' IN ZONE 3
ALARM 'ACTIVE' IN ZONE 15
CHECKSUM

TABLE 2 (E)

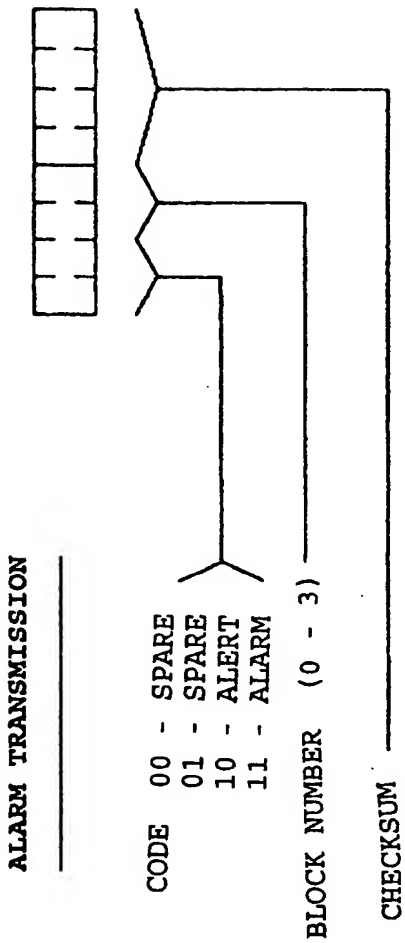

ALARM TRANSMISSION
CODE 00 - SPARE
01 - SPARE
10 - ALERT
11 - ALARM
BLOCK NUMBER (0 - 3)
CHECKSUM

TABLE 2 (F)

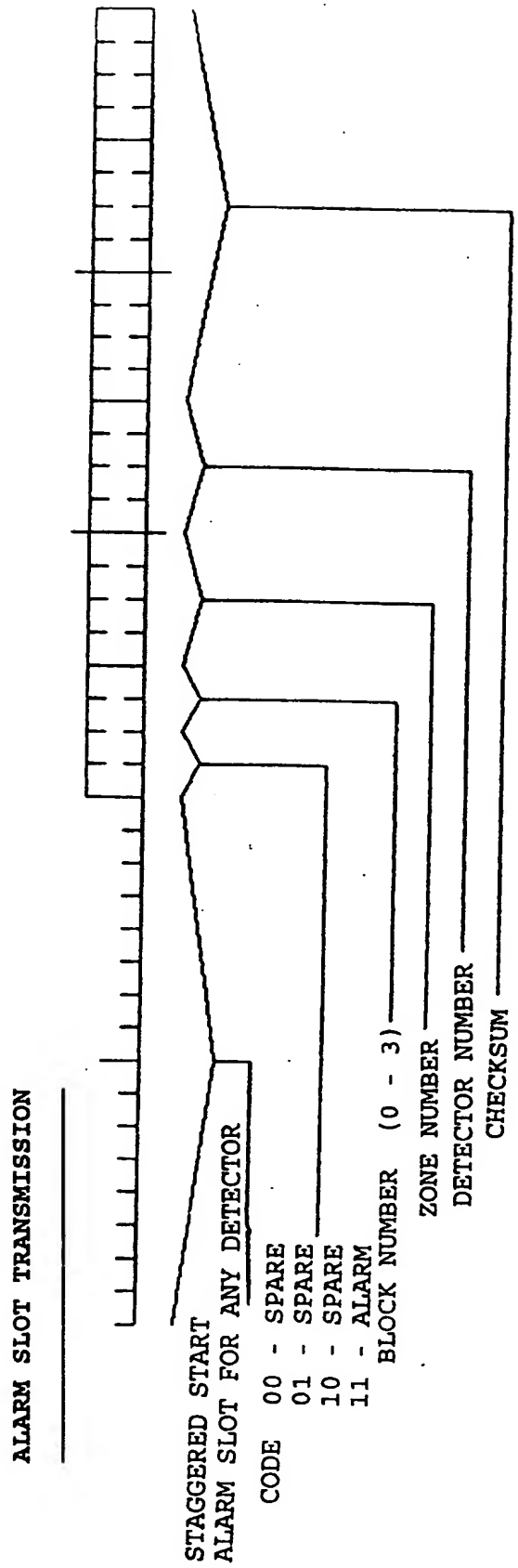

ALARM SLOT TRANSMISSION
STAGGERED START
ALARM SLOT FOR ANY DETECTOR
CODE 00 - SPARE
01 - SPARE
10 - SPARE
11 - ALARM
BLOCK NUMBER (0 - 3)
ZONE NUMBER
DETECTOR NUMBER
CHECKSUM

TABLE 2 (G)

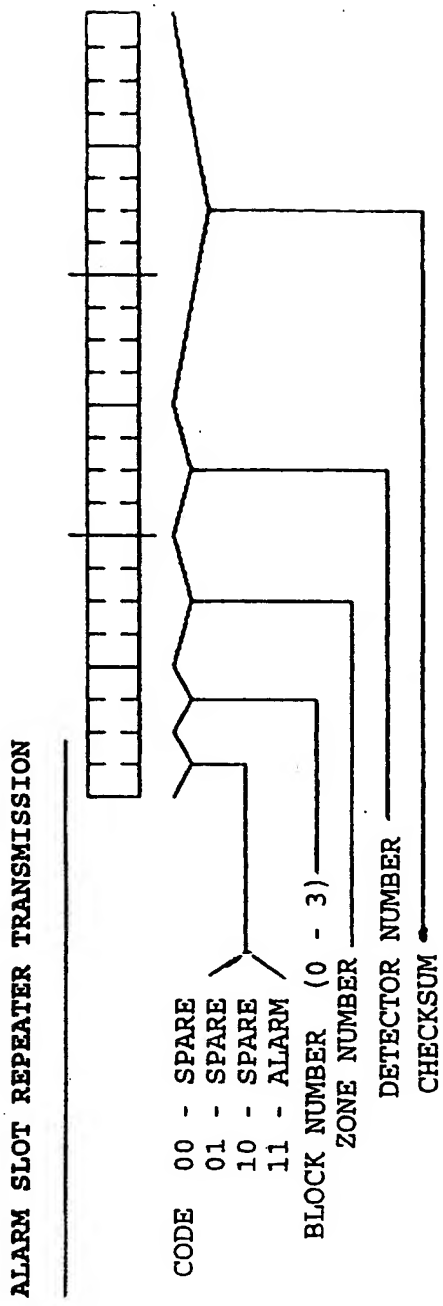

ALARM SLOT REPEATER TRANSMISSION
CODE 00 - SPARE
01 - SPARE
10 - SPARE
11 - ALARM
BLOCK NUMBER (0 - 3)
ZONE NUMBER
DETECTOR NUMBER
CHECKSUM

TABLE 2 (H)

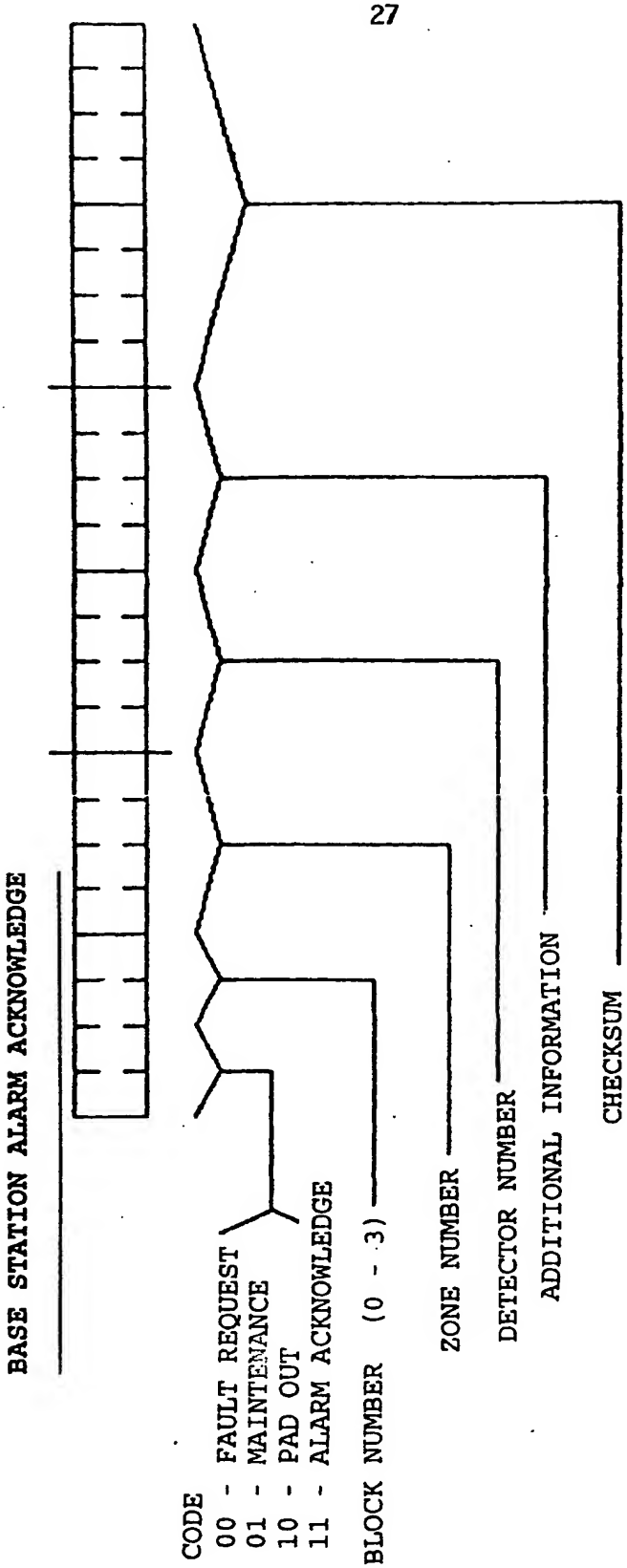
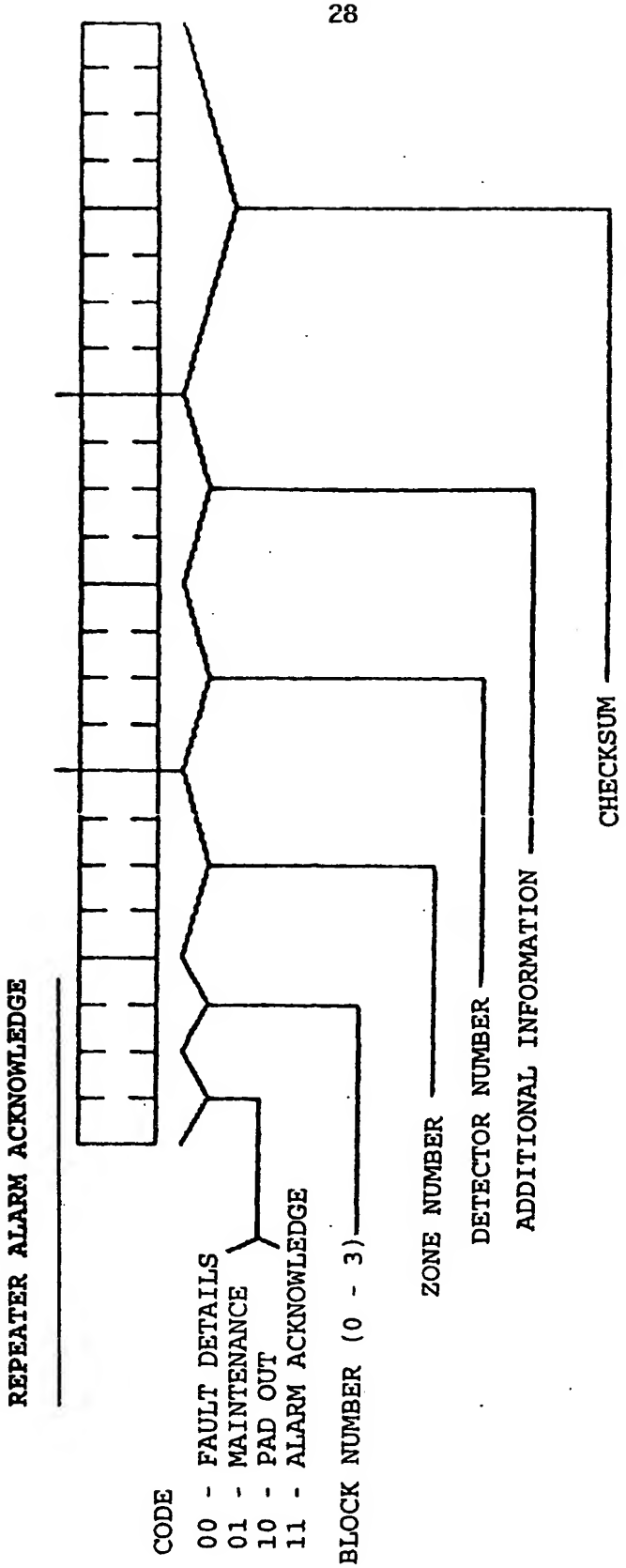

BASE STATION ALARM ACKNOWLEDGE
CODE
00 - FAULT REQUEST
01 - MAINTENANCE
10 - PAD OUT
11 - ALARM ACKNOWLEDGE
BLOCK NUMBER (0 - 3)
ZONE NUMBER
DETECTOR NUMBER
ADDITIONAL INFORMATION
CHECKSUM

TABLE 2 (I)


REPEATER ALARM ACKNOWLEDGE
CODE
00 - FAULT DETAILS
01 - MAINTENANCE
10 - PAD OUT
11 - ALARM ACKNOWLEDGE
BLOCK NUMBER (0 - 3)
ZONE NUMBER
DETECTOR NUMBER
ADDITIONAL INFORMATION
CHECKSUM

CLAIMS

1. A fire detection system characterised by a multiplicity of integrated alarm/detection units (2) arranged to be mounted in different locations, and a control unit (1) arranged to transmit and receive radio signals to and from the alarm/detection units,

each alarm/detection unit comprising a fire sensor (10), alarm means (17) for generating an audible or visible alarm signal, a local control processor (5) connected in common to the sensor and the alarm means, a radio transceiver (19) connected to the local control processor, and a battery power supply for the unit,

the control processor (5) being arranged to switch ON in a predetermined time slot, and when ON to switch between an idle mode with reduced power consumption and an active mode, the processor when in the active mode transmitting to the control unit data indicative of the operational status of the alarm/detection unit, and subsequently switching OFF.

2. A system according to claim 1, in which each of the multiplicity of alarm/detection units (2) is arranged to turn ON and to transmit to the control unit in a different predetermined time slot, and the control unit (1) is arranged to identify transmissions from different units on the basis of their different respective time slots.

3. A system according to claim 2, in which the control unit (1) is arranged to transmit regularly a synchronising signal to the alarm/detection units (2), the alarm/detection units (2) timing their return transmissions to the control unit in response to the synchronising signal.

4. A system according to any one of the preceding claims, in which the radio transceiver (19) comprises separate transmitter and receiver stages and control and switching logic common to the transmitter and receiver stages, each transmitter and receiver stage incorporating a separate oscillator (21,22).

5. A system according to any one of the preceding claims, in which each of the local control processors (5) includes a ceramic resonator oscillator.

6. A system according to any one of the preceding claims, further comprising a repeater (21) arranged to receive transmissions from alarm/detection units (2) distant from the control unit (1), and to retransmit data from the distant alarm/detection units (2) to the control unit (1) in a predetermined time slot.

7. A method of operating a fire detection system comprising a multiplicity of integrated alarm/detection units (2) arranged to be mounted in different locations, and a control unit (1) arranged to transmit and receive radio signals to and from the alarm/detection units (2), each of the alarm/detection units including a fire detector, a local control processor (5), and a radio transceiver (19),

in which the control processor switches ON in a predetermined time slot, and when ON switches between an idle mode of reduced power consumption and an active mode, the processor when in the active mode transmitting to the control unit data indicative of the operational status of the alarm/detection unit, and subsequently switching OFF.

8. A method according to claim 7, in which each of the multiplicity of alarm/detection units (2) turns on and transmits to the control unit (1) in a different predetermined time slot, and the control unit (1) identifies transmissions from different alarm/detection units on the basis of their different respective time slots.

9. A method according to claim 8, in which the control unit (1) transmits at regular intervals a synchronising signal to the alarm/detection units (2) and the alarm/detection units time their return transmissions to the control unit in response to the synchronising signal.

10. A method according to any one of the preceding claims, in which transmissions between the alarm/detection units

(2) and the control unit (1) are carried out in predetermined time slots in a set time frame divided into a number of sub-frames, one slot for the transmission of routine status data from each alarm/detection unit (2) to the control unit (1) being provided in each frame, and an extended slot for the transmission of an alarm code being provided in each of the sub-frames.

11. A method according to claim 10, in which each alarm/detection unit (2) in response to the detection of an alarm condition transmits an alarm code back to the control unit (1) or to a repeater unit in the next occurring sub-frame alarm transmission slot.

12. A method according to claim 11, in which the control unit is arranged to transmit an acknowledgement back to the alarm/detection unit after receiving an alarm code from the alarm/detection units, and in which the alarm/detection unit, in the absence of an acknowledgement from the control unit, repeats the alarm code in a subsequent sub-frame.

Fig. 1.

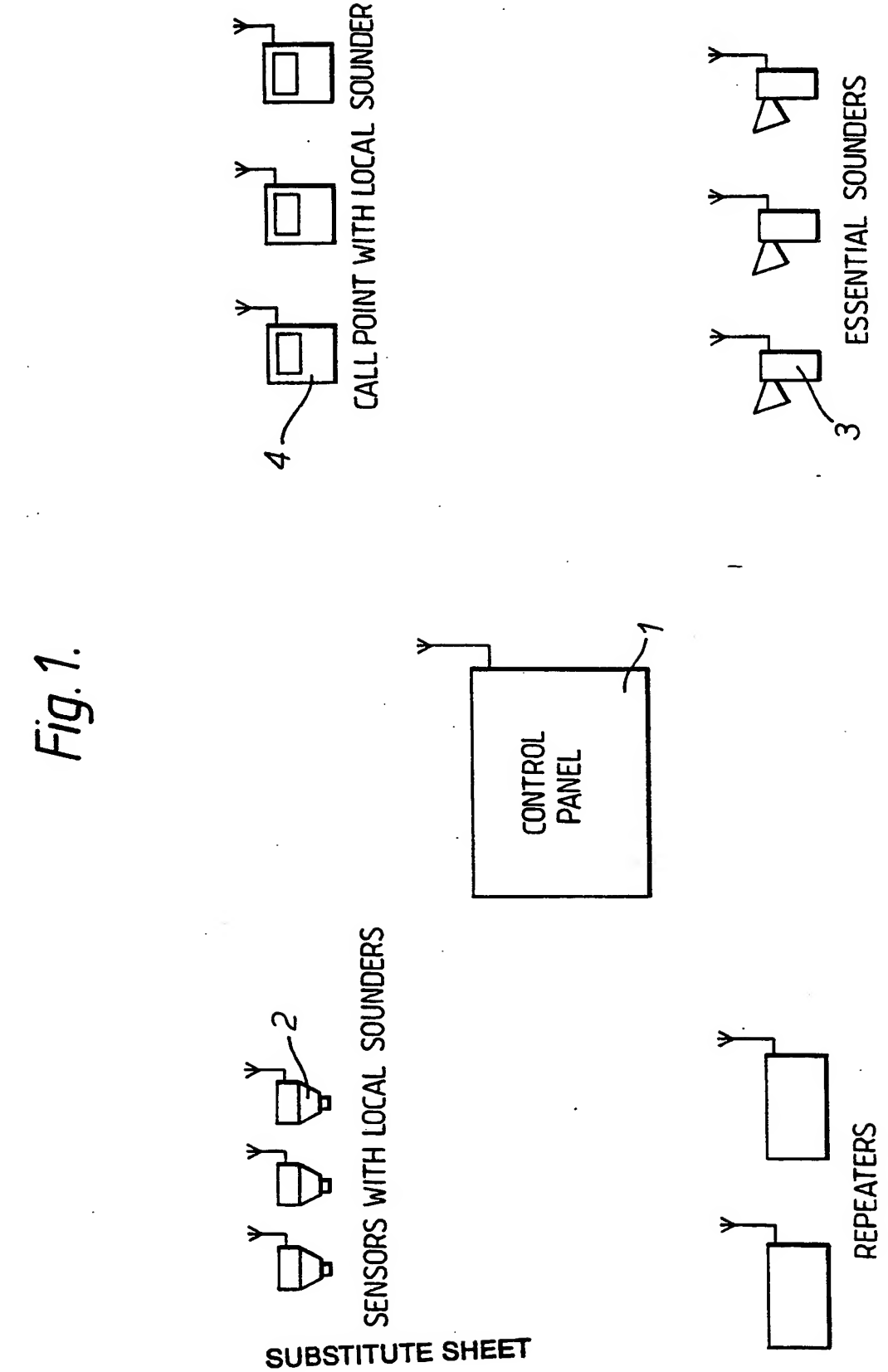

CALL POINT WITH LOCAL SOUNDER
4
ESSENTIAL SOUNDERS
3
CONTROL PANEL
1
SENSORS WITH LOCAL SOUNDERS
2
REPEATERS

Fig.2.

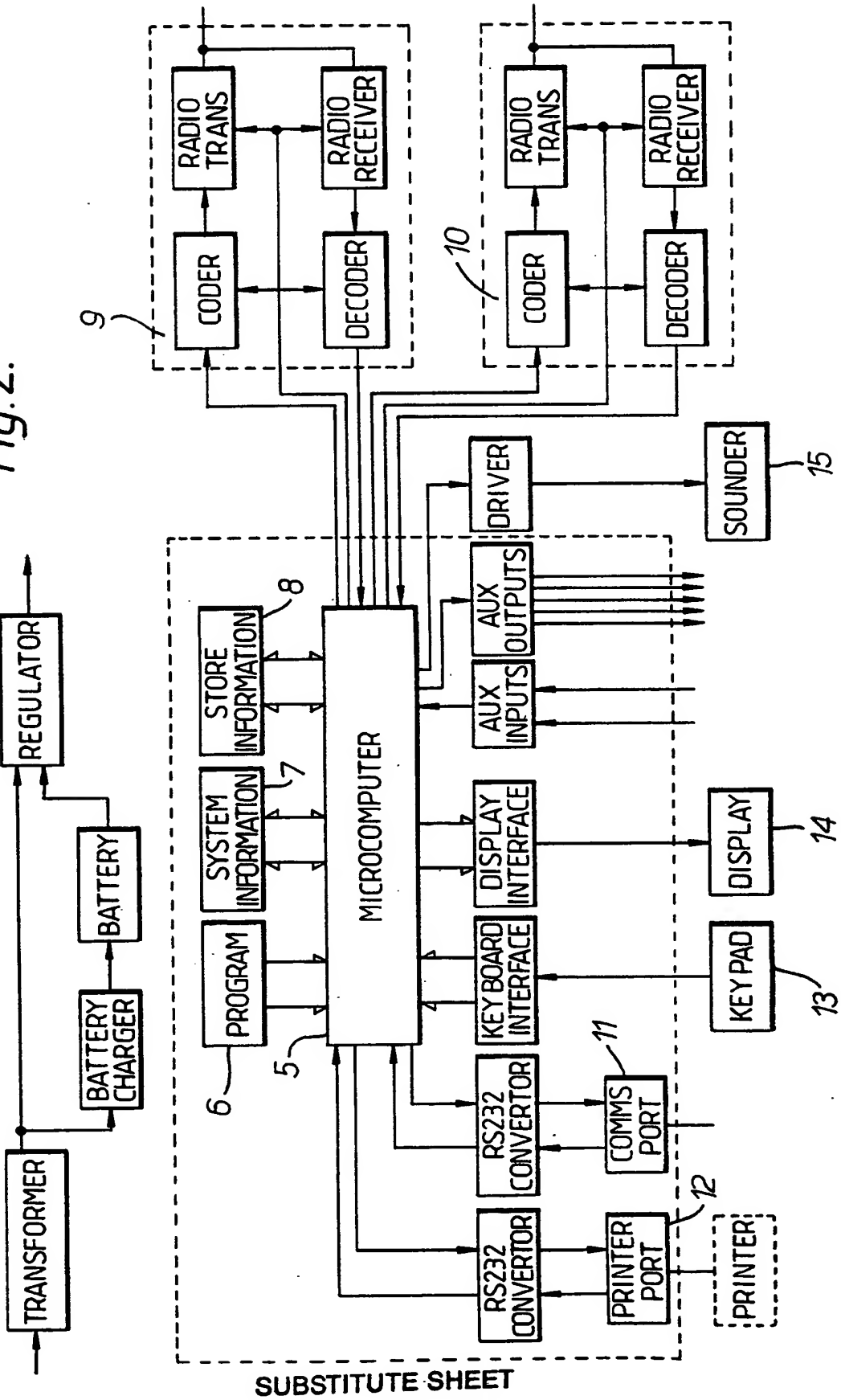
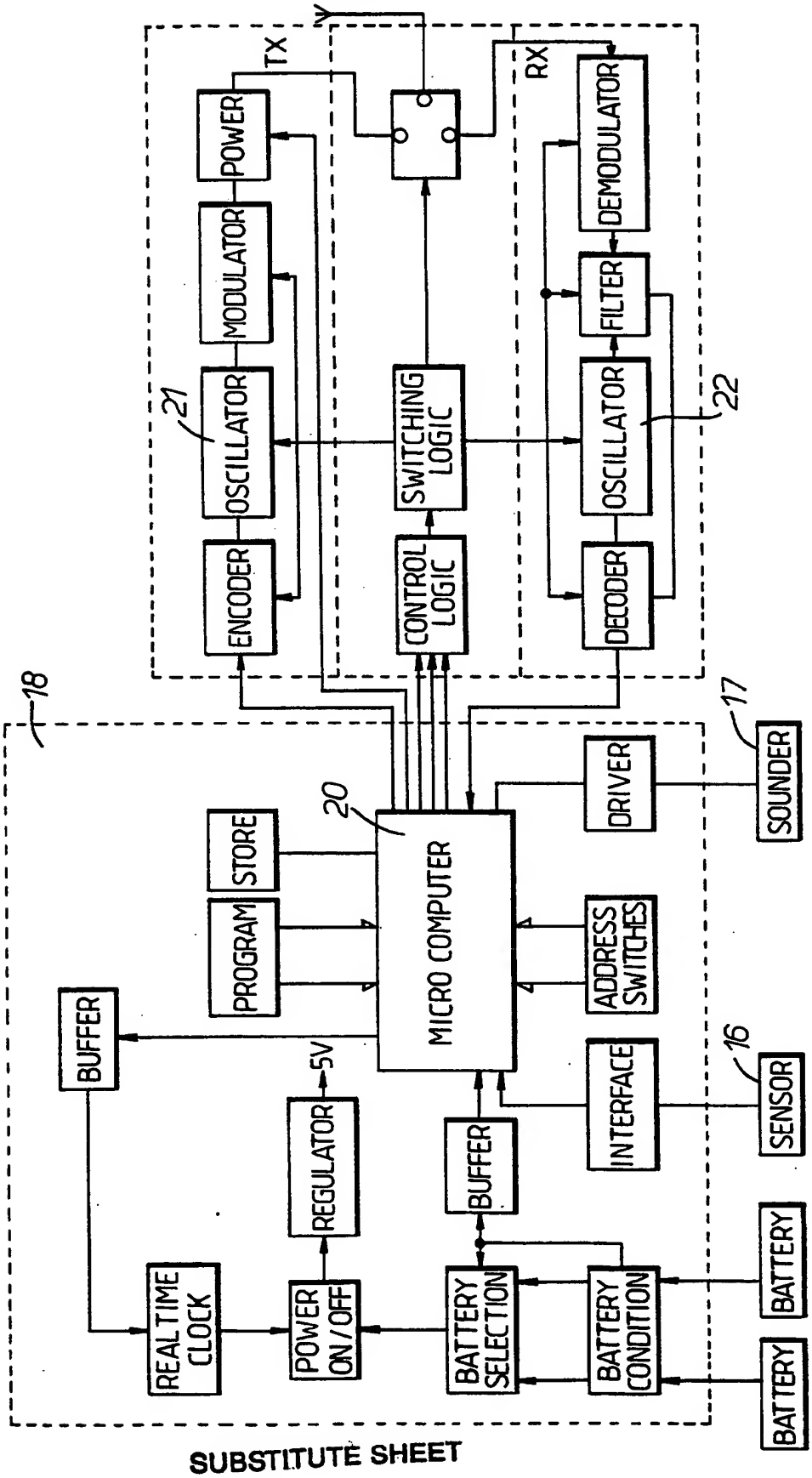

RADIO TRANS
RADIO RECEIVER
CODER
DECODER
9
10
DRIVER
SOUNDER
15
REGULATOR
BATTERY
BATTERY CHARGER
TRANSFORMER
STORE INFORMATION
8
SYSTEM INFORMATION
7
PROGRAM
6
5
MICROCOMPUTER
AUX OUTPUTS
AUX INPUTS
DISPLAY INTERFACE
DISPLAY
14
KEY BOARD INTERFACE
KEY PAD
13
RS232 CONVERTOR
11
COMMS PORT
RS232 CONVERTOR
PRINTER PORT
12
PRINTER

Fig. 3.


TX
RX
POWER
MODULATOR
OSCILLATOR
ENCODER
SWITCHING LOGIC
CONTROL LOGIC
DEMODULATOR
FILTER
OSCILLATOR
DECODER
21
22
18
17
20
DRIVER
SOUNDER
STORE
PROGRAM
MICRO COMPUTER
ADDRESS SWITCHES
BUFFER
5V
REGULATOR
BUFFER
INTERFACE
16
SENSOR
REAL TIME CLOCK
POWER ON/OFF
BATTERY SELECTION
BATTERY CONDITION
BATTERY
BATTERY

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB 93/01653

A. CLASSIFICATION OF SUBJECT MATTER
IPC 5 G08B25/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 5 G08B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	FR,A,2 108 997 (SOUCHERE) 26 May 1972 see page 3, line 10 - page 5, line 20; figure 1	1-4,6-12
Y	EP,A,0 155 773 (PITTWAY CORPORATION) 25 September 1985 see the whole document	1-4,6-12
Y	DE,A,35 29 127 (BROWN, BOVERI & CIE AG) 19 February 1987 see the whole document	2,3,8-11
Y	US,A,4 191 948 (STOCKDALE) 4 March 1980 see column 2, line 46 - column 4, line 28; figures 1,2	10

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 November 1993	07. 12. 93

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016	WANZEELE, R

Form PCT/ISA/210 (second sheet) (July 1992)

International application No.
PCT/GB 93/01653

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	GB,A,2 190 526 (CW PRODUCTS INC.) 18 November 1987 see page 3, line 102 - line 108	12

INTERNATIONAL SEARCH REPORT

information on patent family members

International application No.
PCT/GB 93/01653

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
FR-A-2108997	26-05-72	NONE		
EP-A-0155773	25-09-85	US-A-	4575712	11-03-86
		DE-A-	3583878	02-10-91
DE-A-3529127	19-02-87	NONE		
US-A-4191948	04-03-80	NONE		
GB-A-2190526	18-11-87	US-A-	4777488	11-10-88